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NOTES ON GEOGRAPHIC DISTRIBUTION

Range extension of *Lymnaea* cf. *biacuminata* Annandale & Rao, 1925 (Mollusca: Gastropoda: Hygrophila: Lymnaeidae), with its first record from Maharashtra state, India

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ABSTRACT: *Lymnaea biacuminata* Annandale & Rao, 1925, is a rare freshwater snail with less than 10 locality records in the states of Telangana, Madhya Pradesh, and Uttarakhand of India. This species is taxonomically problematic and its relationship to the morphologically similar *L. acuminata* Lamarck, 1822, unresolved. We identify *L. biacuminata* from Maharashtra for the first time and this species' distributional range to Pune, about 500 km westwards from the type locality at Hosainsagar lake between Hyderabad and Secunderabad in Telangana. In Maharashtra, we found *L.* cf. *biacuminata* sympatric with *L. acuminata*. To aid in distinguishing between these two species, additional information on breeding behaviour and shell morphometry of both species are provided.

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Lymnaea biacuminata Annandale & Rao, 1925, is a freshwater snail of the family Lymnaeidae (Mollusca: Gastropoda: Hygrophila) found in stagnant waters (Budha *et al*. 2010). This species was previously reported in India from one location, Hosainsagar lake (the type locality) between Hyderabad and Secunderabad in the state of Telangana (formerly part of Andhra Pradesh state), 3 locations (Bhopal, Damoh, and Sagar) in Madhya Pradesh, and 4 locations (Dehradun, Kumaon, Nainital, and Tehri) in Uttarakhand (Annandale and Rao 1925; Subba Rao 1989; Ramakrishna and Dey 2007; Bhide *et al*. 2007; Budha *et al*. 2010; Vyas and Bhat 2010) (Figure 1). Subba Rao (1989) thought it to be a phenotypic variant of *L. acuminata* Lamarck, 1822 (form *rufescens* Gray, 1822) and the taxonomy of these taxa remains unresolved. Due to similar shell morphologies (acuminate spire and convex outer lip of aperture) of *L. biacuminata* with *L. acuminata* and a lack of information on breeding behaviour, *L. biacuminata* might have been misidentified by many researchers. Thus, further investigation, and taxonomic study of this and related species, is needed to confirm their distribution in India.

Some lymnaeids can act as an intermediate host of the parasites that cause diseases such as schistosomiasis and amphistomiasis in various mammals including humans (Subba Rao 1989; Ramakrishna and Dey 2007). For this reason, it is important to know the distribution as well as population ecology, life history, and breeding behaviour of *Lymnaea* spp. Herein, we report for the first time *L.* cf. *biacuminata* from Maharashtra state, India, and extend its known range to Pune, about 500 km west of the type locality at Hosainsagar tank between Hyderabad and Secunderabad, Telangana (Figure 1). Additional information is provided on breeding behaviour and shell morphometry of *L.* cf. *biacuminata*. We compare *L.* cf. *biacuminata* with the morphologically similar and sympatric, *L. acuminata*.

Lymnaea cf. *biacuminata*, along with L. acuminata, was found in an artificial pond (1.5–2 m depth with aquatic vegetation of *Hydrilla* and water lily) of the Department of Botany, University of Pune, Maharashtra

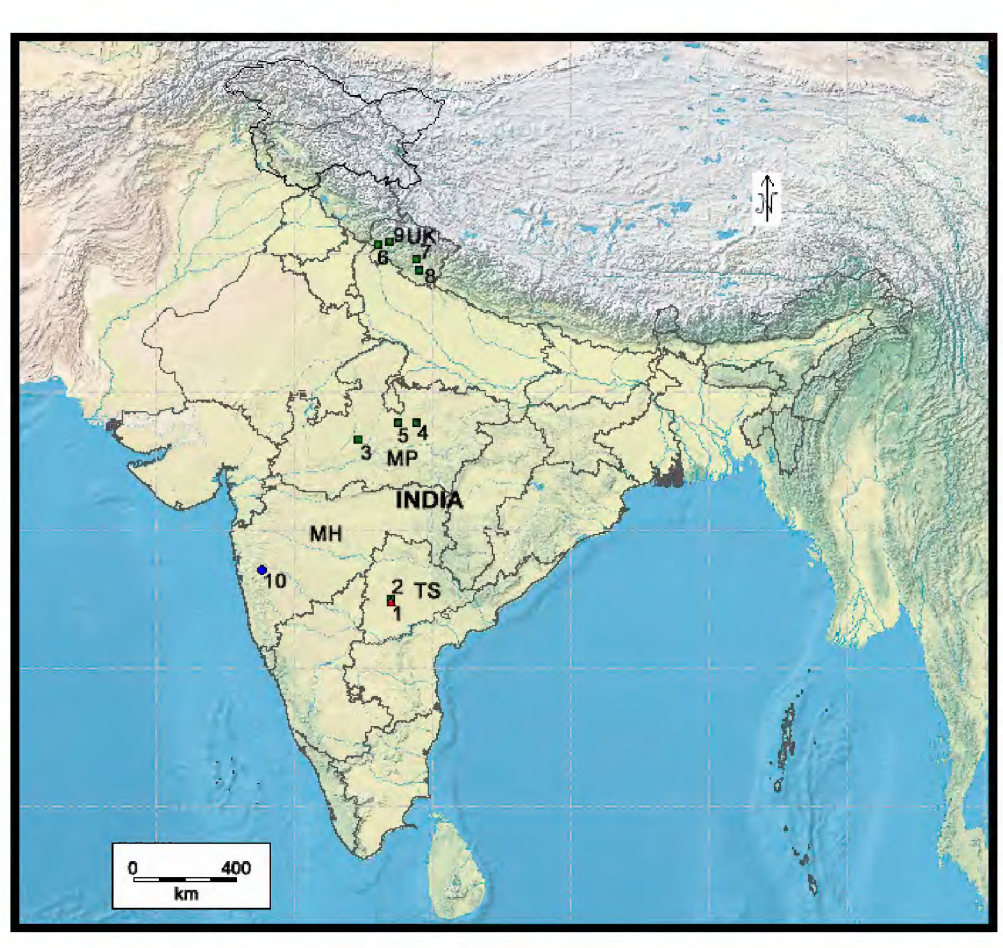

FIGURE 1. Distribution map of *Lymnaea biacuminata* in India. 1, Hyderabad; 2, Secunderabad; 3, Bhopal; 4, Damoh; 5, Sagar; 6, Dehradun; 7, Kumaon; 8, Nainital; 9, Tehri; 10, Pune (new record); MH, Maharashtra; MP, Madhya Pradesh; TS, Telangana; UK, Uttarakhand.

State, India (18.54833412° N, 73.82478297° E; 585 m altitude). *Lymnaea biacuminata* has a thin, fragile, and elongated spindle-shaped shell (Annandale and Rao 1925; Ramakrishna and Dey 2007). The spire is very short and narrow. The last whorl is inflated. The aperture is very large, ovate and projecting forward much beyond the body whorl in ventral view, with the outer lip projecting noticeably in a wide arc and tapering anteriorly. The anteriorly narrowed aperture and spire give the shell a spindle-shape. The columella is slightly twisted and has a broad fold that extends forwards slightly more than half of aperture height. A well-developed callus extends from the fold to the upper lip. The umbilicus is occluded by the callus. Fine, curved, longitudinal striae are present on the shell. Our specimens were compared with the description and figure of the type specimen from the original literature (Annandale and Rao 1925). The present specimens generally agree with the types except for the extent of bilateral asymmetry, *i.e.,* the arc of the outer lip is comparatively narrow than that of *L. biacuminata* (Figures 2a and 2b *vs.* Annandale and Rao 1925: Figure III, 2). However, the present specimens and the types have acuminate structures at both the ends of the shell giving a spindle-shape. Thus, our specimens can be still compared with *L. biacuminata*. At present, we are not sure about correct identity of our specimens. However, it is noteworthy to report our specimens as *L.* cf. *biacuminata*, whose taxonomy may be resolved in near future through some other methods such as molecular analysis and anatomical studies, especially with regard to prostate glands. Because *L.* cf. *biacuminata* is sympatric with *L. acuminata*, it is difficult to distinguish juveniles. Breeding behaviour of *L. biacuminata* could be useful in identification, but it is not yet known.

Juvenile specimens of each *Lymnaea* spp. were collected from the artificial pond and were grown to maturity in the laboratory for 47 days (20 November 2013 to 5 January 2014). Twenty specimens of each species were kept in two separate containers, each holding 2 L of dechlorinated tap water at room temperature (20–23°C). A complete exchange of water was done daily. Both species were fed the same food (*Hydrilla*) and had the same substratum (water lily). Behaviour of each species was noted during the rearing period, and length, width, and aperture height of shells were measured at the end of the culture using a slide caliper. Reared specimens along with some fresh collections from the same site were preserved dry and deposited in the National Zoological Collection of Zoological Survey of India, Western Regional Centre, Pune, with registration numbers ZSI-WRC-Moll.1495 for *L.* cf. *biacuminata* and ZSI-WRC-Moll.1496 for *L. acuminata*.

During the rearing period, egg masses (colourless) of both the species were observed to be laid on the lower side of the substratum (water lily leaves). Frequency of egg laying was 10–20 d for *L.* cf. *biacuminata* and 3–4 d for *L. acuminata*. Average egg count per clutch was 10–15 for *L.* cf. *biacuminata* and 15–20 for *L. acuminata*. Shell length, width and height of aperture were measured to be 8.7–17.7 mm (12.72±1.94 mm), 4.2–8.2 mm (6.37±0.97 mm) and 6.2–13.3 mm (8.88±1.62 mm), respectively for *L.* cf. *biacuminata* and 10.0–14.5 mm (12.75±1.06 mm), 5.2–8.7 mm (7.31±0.84 mm) and 6.3–10.2 mm (8.39±0.92 mm), respectively for *L. acuminata*.

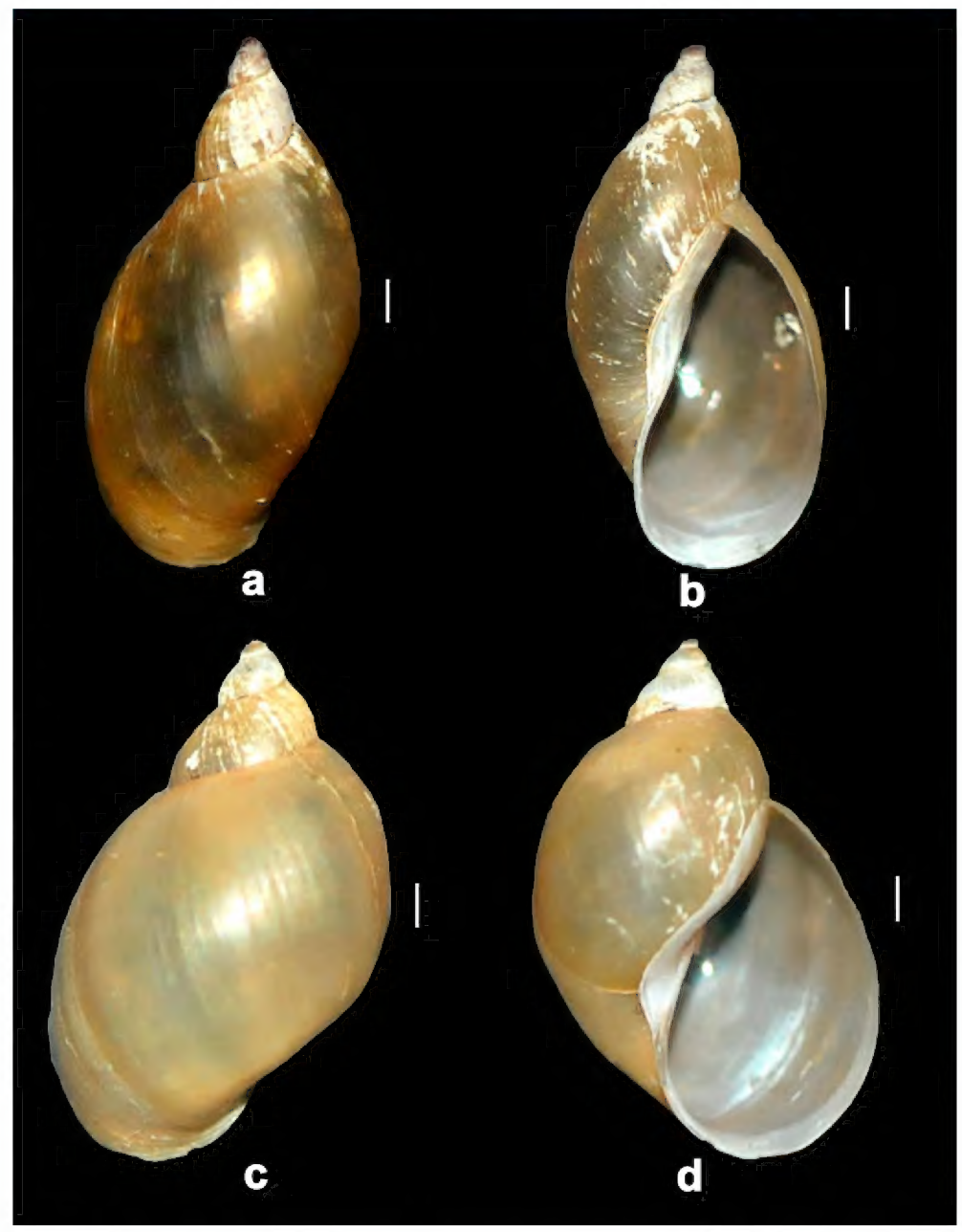

FIGURE 2. Shell of *Lymnaea* cf. *biacuminata* Annandale & Rao, 1925 (ZSI-WRC-Moll.1495) (a and b) and *Lymnaea acuminata* Lamarck, 1822 (ZSI-WRC-Moll.1496) (c and d): a and c, abapertural views; b and d, apertural views. Scale bars = 1 mm.

Intraspecific life history differences in populations of some members of Lymnaeidae (*e.g., Radix peregra* (Müller, 1774)) are due to microevolutionary adaptations to local selection pressures; that is, there is at least some genetic basis (Calow 1981; Lam and Calow 1989, 1990). However, these interpopulation life history differences were reduced due to maternal influences with no evidence of genetic basis under laboratory conditions (Lam 1994). Therefore, the differences noted in the breeding behaviour (frequency of egg laying and clutch size of egg masses) of the two populations suggested that both the populations do not belong to a single species. Furthermore, the mean width of the shell in proportion to its mean length is different in both the species (*i.e.*, the shell of *L.* cf. *biacuminata* is comparatively narrow than *L. acuminata*; Figure 2a–d). The shell of *L.* cf. *biacuminata* is clearly differentiated from *L. acuminata* by the following characters: spire less broad (*vs.* spire broader); body whorl less inflated (*vs.* body whorl more inflated); columella with a flat callus posteriorly (*vs.* columella with a slightly convex callus posteriorly); aperture narrowly ovate in outline (*vs.* aperture broadly ovate in outline); outer lip of aperture more tapered anteriorly (*vs.* outer lip of aperture less tapered anteriorly) (Figures 2a and 2b *vs.* 2c and 2d).

Occurrence of *L.* cf. *biacuminata* in an artificial pond at Pune leads to several assumptions. The species could be introduced into the artificial pond along with the aquatic vegetation by the university. If this is true then the aquatic plants were most probably brought from nearby habitats. Zoological Survey of India, Pune has been carrying out regular surveys in and around Pune since last five decades.

However, the species was not recorded so far. In these circumstances, we can assume that the species might have been introduced recently. Even then, it is difficult to rule out presence of the species in natural environment of Pune and probably in other parts of the state, because it was reported from distant localities with varying latitudinal ranges. It is also possible that the species might have been overlooked by the previous researchers due to difficulties with its identity. Thus, further taxonomic and biogeographical studies on lymnaeids of Maharashtra as well as the country would be helpful for future workers.

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